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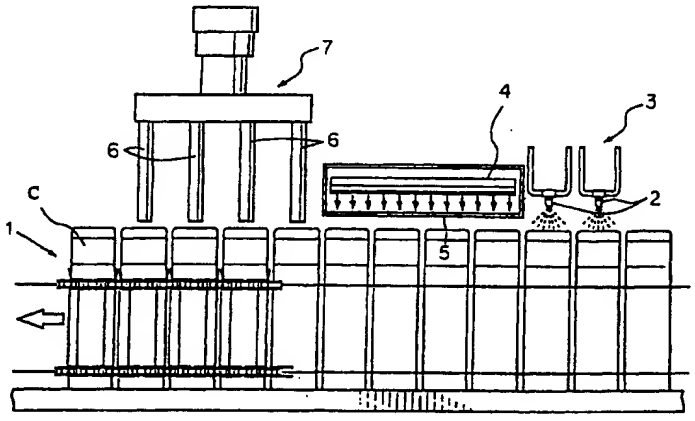
(54) Method of and apparatus for sterilizing food packaging material

(57) A sterilizing apparatus capable of sterilizing within a processing time corresponding to a line speed of a packing and packaging machine, as well as capable of preventing odoriferosity, deterioration of seal strength and scorching on printed surfaces caused by the irradiation of high power pulses under a high light emission energy in a case of applying a sterilizing method by using high power pulses from xenon lamps to the food packaging material is provided, wherein the apparatus comprises a means for depositing a liquid having an antibacterial function such as aqueous hydrogen peroxide at a low concentration to the food packaging material by spraying or immersion and a means for irradiating high power pulses using the xenon lamps to the food packaging material deposited with the liquid having the antibacterial effect.

Fig. 1



Does NOT use Oxygen Scavenging Polymers.

Uses Plasma Lamps

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Description

[0001] The present invention concerns a method of and an apparatus for sterilizing food packaging materials used in a food packing and packaging machine and, more in particular, it relates to a method of and an apparatus capable for sterilizing food packaging materials at a speed corresponding to a line speed of a packing and packaging machine by using a liquid having an antibacterial effect and pulse irradiation at high power from xenon lamps together.

[0002] Heretofore, as a method of sterilizing packaging materials for foods such as paper pack-incorporated milk, a method of using aqueous hydrogen peroxide at a high concentration of 35% has been known mainly (refer to Japanese Patent Publication No. 4078/1973). However, in the sterilization by using only the aqueous hydrogen peroxide, it is necessary to deposit a great amount of aqueous hydrogen peroxide to the packaging material or make the time of contact between the aqueous hydrogen peroxide and the packaging material relatively longer, which results in a problem that it takes a long time for a decomposing/removing step by hot blow or a cleaning step with aseptic water, in order to remove the aqueous hydrogen peroxide remaining on the surface of the packaging material.

[0003] In addition, UV-ray irradiation has been well-known as a method of sterilizing food packaging materials. However, the sterilization by the irradiation of UV-rays is a surface sterilization and involves problems that sterilization is not obtained for non-irradiated areas and in case the energy of UV-rays is low, when an obstacle is present or when the bacteria layer is thick, UV-rays can not transmit the material, so that no sufficient sterilizing effect can be obtained.

[0004] Further, a sterilization method of using the above-mentioned aqueous hydrogen peroxide and UV-ray irradiation together has also been well-known (refer to Japanese Patent Laid-Open No. 113530/1981, Japanese Patent Publication No. 66142/1993 and Japanese Patent Laid-Open No. 156/1995). However, also this sterilizing method involves a problem inherent to UV-ray irradiation, that is, the sterilizing effect is sometimes low depending on the difference of sensitivity of microorganisms to UV-rays. For example, it is necessary to increase the irradiation dose of UV-rays and increase the irradiation time in order to improve the sterilizing effect in a case such as for sterilization of Aspergillus niger but it can not still overcome the problem of giving damages to the packaging materials such as odoriferosity or discoloration in long time irradiation.

[0005] On the other hand, a method of sterilization of irradiating high power pulses to food packaging materials by using xenon lamps has also been known. For example, Japanese Patent Publication No. 58874/1985 discloses a sterilization method of emitting light from a flashing discharge lamp, of which light emitting constituents are rare gases, irradiating the emitted light through a quartz wall to products to be processed which are transported successively to reach a sterilizing station thereby sterilizing bacteria on the surface of the products to be processed. The patent publication discloses that a higher sterilizing effect than that of UV-ray lamps can be obtained in this sterilizing method by light emission pulses for 8 sec (emission for 40 cycles) and same sterilizing effects can be obtained even with fewer frequency of light emission as the light emission energy is increased.

[0006] It has also been known that the sterilizing effect by the xenon lamps depends on an electric energy (voltage) inputted to a lamp, capacity of a condenser, pulse width, irradiation distance and the number of irradiation cycles, and that the sterilizing effect is enhanced more as the electric energy (voltage) and the number of irradiation cycles are increased and as the pulse width and the irradiation distance are decreased.

[0007] Light emission from a xenon lamp has a feature in emitting an extremely large amount of light in an extremely short period of time and it is said that the instantaneous light emission power is as high as from 10^4 to 10^7 times the power of existent UV-ray sterilizing lamps. Therefore, the sterilizing method using high power pulses from the xenon lamps has a sufficient sterilizing power also to Aspergillus niger and the like, for which UV-ray irradiation is said to be able to provide only poor sterilizing power, so it can be said to be an excellent sterilizing method. However, it requires a number of light emission cycles in order to obtain a high sterilizing power at a low light emission energy. When sterilization is conducted by a high light emission energy while decreasing the number of light emission cycles as few as possible, since the working life of the lamp is determined by the number of emission cycles, there is a problem that it requires a long time for storing the energy and enlarges the scale of the power source and the apparatus, which makes the apparatus expensive in view of the cost.

[0008] The performance and the operation speed have been improved outstandingly in recent food packing and packaging machines, and sterilization capable of corresponding with high line speed has also been demanded for the sterilizing step of packaging materials. In order to conduct sterilization at a speed corresponding to the line speed by using high power pulses from xenon lamps, it is necessary to apply a pulse light treatment at high light emission energy. In case of sterilizing food packaging materials including plastic materials under the conditions described above, while there is no undesired effect on an adaptable standard as foods or on the mechanical strength of the packaging containers, it has been pointed out a problem of increase in a scale of the apparatus as described above, as well as a problem of some odoriferosity or deterioration of the sealing strength after irradiation and scorching on printed surfaces when irradiation is applied to the printed surface.

[0009] An object of this invention is to provide a method of and an apparatus for sterilization that can conduct sterilization within a processing time corresponding to the line speed of a packing and packaging machine, and prevent

odoriferosity and deterioration of sealing strength and scorching on the printed surfaces caused by irradiation of high power pulses at a high light emission energy, in case of applying a sterilizing method using high power pulses from xenon lamps to food packaging materials.

[0010] The present inventors have made an earnest study to overcome the foregoing problems and have accomplished the present invention based on the finding that sterilization can be conducted in a sterilization for food packaging materials of irradiating high power pulses by xenon lamps at a relatively low light emission energy not causing odor, deterioration of sealing strength and scorching on the printed surfaces and within a processing time corresponding to a line speed of a packaging and packing machine by previously depositing a liquid having an antibacterial effect, for example, an aqueous hydrogen peroxide at a concentration of 0.1 to 10% by weight on the surface of the food packaging material to be irradiated.

[0011] That is, this invention provides a method of sterilizing a food packaging material which comprises irradiating high power pulses by using the xenon lamps in a state in which a liquid having an antibacterial effect is deposited on the food packaging material.

[0012] In a preferred embodiment of the method of sterilizing the food packaging material described above, the liquid having the antibacterial effect is selected from aqueous peracetic acid, aqueous hydrogen peroxide containing peracetic acid, aqueous hydrogen peroxide, ozone-containing water, ethanol, sodium chloride solution, electrolyzed acidic water, and an organic or inorganic acid solution.

[0013] In a preferred embodiment of the method of sterilizing the food packaging material described above, the liquid having an antibacterial effect comprising at a concentration of an effective ingredient of 0.1 to 10% by weight is used as the liquid having the antibacterial effect.

[0014] Further, the present invention provides an apparatus for sterilizing a food packaging material comprising,

a means for depositing a liquid having an antibacterial effect on a food packaging material and
a means for irradiating high power pulses by using xenon lamps to the food packaging material deposited with the liquid having the antibacterial effect.

[0015] In a preferred embodiment of the sterilizing apparatus described above, the food packaging material has a polyolefin layer on the surface.

[0016] In a preferred embodiment of the sterilizing apparatus for the food packaging material described above, the means for depositing the liquid having the antibacterial effect on the food packaging material is one of a spray device of a liquid having the antibacterial effect on the food packaging material, a means for coating the liquid having the antibacterial effect and an immersion device of dipping the material into the liquid having the antibacterial effect.

[0017] In a preferred embodiment of the sterilizing apparatus for the food packaging material as described above, the xenon lamps have spectral characteristics having continuous spectra of a wide range of wavelength from ultraviolet to infrared regions.

[0018] In a preferred embodiment of the sterilizing apparatus for the food packaging material as described above, the xenon lamps have a light emission energy of from 50 to 1000 Joule.

[0019] In a preferred embodiment of the sterilizing apparatus for the food packaging material as described above, the sterilizing apparatus for the food packaging material has a preheating section capable of heating the surface temperature of the food packaging material to 40 - 80°C in a step prior to deposition of the liquid having the antibacterial effect on the food packaging material.

[0020] In a preferred embodiment of the sterilizing apparatus for the food packaging material as described above, the sterilizing apparatus for the food packaging material has a drying device for removing the liquid having the antibacterial effect deposited on the food packaging material in a step after the irradiation of high power pulses by using the xenon lamps to the food packaging material deposited with the liquid having the antibacterial effect.

[0021] The food packaging material as an objective of sterilization in this invention can include those packaging materials in which a polyolefin layer such as polyethylene or polypropylene is laminated to a paper layer and/or aluminum foil layer on the surface, packaging materials comprising plastic materials such as polyethylene, polystyrene, polypropylene and PET (polyethylene terephthalate). Particularly, the effect of this invention can be attained advantageously for those food packaging materials having a polyolefin layer such as the same of polyethylene on the surface, which causes problems such as odoriferosity, deterioration of seal strength and scorching on the printed surfaces when sterilization is applied by merely using high power pulse irradiation of the xenon lamps.

[0022] Any liquid having the antibacterial effect is usable in this invention so long as it has an antibacterial effect or sterilizing effect in a liquid state such as a liquid antibacterial ingredient or a solid antibacterial ingredient dissolved in the form of an aqueous solution and it specifically includes, for example, aqueous peracetic acid, aqueous hydrogen peroxide containing peracetic acid, aqueous hydrogen peroxide, ozone-containing water, ethanol, sodium chloride solution, electrolyzed acidic water, and an organic acid solution r inorganic acid solution. Then, the liquid having the antibacterial effect as described above is preferably at a concentration of the effective ingredient usually from 0.1 to 10%

by weight, depending on th kind of antibacterial ingredient, in view of shortening of the sterilizing time and removabl of residual antibacterial ingredient.

[0023] As a method of depositing the liquid having the antibacterial effect on the food packaging material in this invention, known methods in the relevant field of the art such as those described in Japanese Patent Laid-Open No. 113530/1981, Japanese Patent Publication No. 66142/1993 and Japanese Patent Laid-Open No. 156/1995 can be adopted. The deposition method can include, for example, a method of using an apparatus for spraying a liquid having an antibacterial effect to a food packaging material and a method of using an apparatus for coating a liquid having an antibacterial effect or a method of immersing the material into a liquid having an antibacterial effect.

[0024] As a device for irradiating high power pulses by using xenon lamps on a food packaging material deposited with a liquid having an antibacterial effect in this invention, the xenon lamps capable of irradiating high power pulses can be mentioned and such xenon lamps can include, for concrete example, those described in Japanese Patent Publication No. 58874/1985 or PURE BRIGHT (manufactured by Pure Pulse Technology Co.).

[0025] The xenon lamps used in this invention preferably have spectral characteristics having continuous spectra for a wide range of wavelength from ultraviolet to infrared regions, particularly, for far ultraviolet region (200 - 300 nm), near ultraviolet region (300 - 380 nm), visible light region (380 - 780 nm) and infrared region (780 - 1100 nm). Further, the xenon lamps having a light emission energy from 50 to 1000 Joule/lamp are, preferably used in view of the cost for the apparatus, scale of the apparatus and the working life of the lamp.

[0026] In the method of sterilizing the food packaging material according to this invention, when high power pulses are irradiated by using xenon lamps in a state of depositing a liquid having an antibacterial effect on the food packaging material, damages caused by high power pulse irradiation to the packaging material can be moderated due to the presence of a liquid phase, as well as the effective ingredient in the liquid having the antibacterial effect is activated by the light energy and, at the same time, the liquid is heated by infrared rays in the high power pulses, so that the sterilizing effect is further improved by the synergistic effect between the activated material and the high power pulse emission from the xenon lamp, and the effect of elongating the temperature of the liquid. Therefore, the damages to the packaging material can be moderated by lowering the light emission energy per once compared with the case of sterilization by merely using the high power pulse irradiation from the xenon lamp, and the sterilizing time can be shortened since a high sterilizing effect can be obtained even when the number of emission cycles is decreased.

[0027] It is necessary that the apparatus for sterilizing the food packaging material according to this invention has a means of depositing a liquid having an antibacterial effect on a food packaging material and a means for irradiating high power pulses by using xenon lamps to the food packaging material deposited with the liquid having the antibacterial effect. It is preferred to dispose a pre-heating section capable of heating the surface temperature of the food packaging material to 40 - 80°C in a step before depositing the liquid having the antibacterial effect on the food packaging material, and a drying device for removing the liquid having the antibacterial effect deposited on the food packaging material in the step after irradiation of high power pulses by using the xenon lamps to the food packaging material deposited with the liquid having the antibacterial effect. Provision of the pre-heating section can further enhance the antibacterial effect due to the liquid having the antibacterial effect and accelerate removal of the antibacterial ingredient in the drying by heating. As the drying device described above, known devices such as described in the Japanese Patent Publication No. 4078/1973, Japanese Patent Laid-Open No. 113530/1981, Japanese Patent Publication No. 66142/1993, and Japanese Patent Laid-Open No. 156/1995 can be used.

[0028] Application examples of an apparatus for sterilizing food packaging materials according to this invention are to be explained below with reference to Fig. 1 and Fig. 2.

[0029] Fig. 1 is an explanatory view in which the apparatus is applied to the gable roof top type paper container. When cartons C each opened at an upper end, which is a bottomed cylinder as an article to be processed, are conveyed successively articles to be processed to a sterilizing station by way of a continuous or intermittently moving conveyor 1, a liquid having an antibacterial effect is sprayed by a liquid spray device 3 having a spray nozzle 2 to the inside of the cartons C, and then high power pulse light is irradiated from xenon lamps 4 through an irradiation window 5 made of quartz glass into the cartons C in a state where the liquid having an antibacterial effect is deposited thereto. Then, drying nozzles 6 are introduced into the cartons C, aseptic air heated by a drying heater 7 is sprayed from the drying nozzles 6 into the cartons C to remove the liquid in the cartons C by hot blow drying.

[0030] Fig. 2 is an explanatory view in which an apparatus for sterilizing a food packaging material according to this invention is applied to a plate web for brick-shaped paper container. A plate web W as an article to be processed is unwound from a rolled state and conveyed continuously, immersed in an immersion tank 8 filled with a liquid having an antibacterial effect, irradiated on both the surfaces of the plate web W by a high power pulse light from xenon lamps 4 in a state where a liquid having an antibacterial effect is deposited thereon, then an aseptic air heated by a drying heater is sprayed from an air knife 9 to both the surfaces of the plate web W and the liquid is removed by hot blow drying. The plate web W applied with the sterilizing treatment described above is conveyed within an aseptic chamber and then shaped into a cylindrical form, to which a liquid food such as juice is filled from a filling pipe 10, separated from th seal by a sealing jaw 11 and then formed into a final product as a brick-shaped container 12.

[0031] This invention is to be explained more specifically with referenc to examples but the technical scope of this invention is not restricted only to such examples.

Example 1

[0032] Bacillus subtilis var globigii spore, IFO 13721 was used as target bacteria and a liquid suspension of spores of the bacteria was prepared, which was spot-inoculated to a sterilized packaging material strip by 10 µl followed by drying, to prepare two kind of bacteria inoculated strips with a initial number of bacteria at 2.3×10^4 cfu/strip and 2.2×10^6 cfu/strip, and served for a sterilizing test. Aqueous hydrogen peroxide at a concentration of 0.1% by weight and 1.0% by weight was sprayed for one sec to each of the bacteria-inoculated strips respectively by hand spray, fixed at a position at 2 cm just beneath the xenon lamps, irradiated with high power pulses from xenon lamps for 1 sec, 5 sec and 10 sec in a state deposited with the aqueous hydrogen peroxide, the strip was recovered in 10 ml of a DTB liquid culture medium, cultivated at 35°C for 10 days to confirm viability/mortality of bacteria. The high power pulses were irradiated by using four xenon lamps and irradiation was conducted under the conditions with a light emission energy per once of 120 Joule/lamp, at light emission for three times in one sec, and an effective irradiation window of area of 30 x 30 cm. The DTB liquid culture medium for recovery with addition of catalase at 5000 units/10 ml (culture) for decomposition of hydrogen peroxide was used. Further, for observing the effect in the combined use with aqueous hydrogen peroxide, a sterilizing test was conducted also for the specimens subjected only to the xenon lamp irradiation without spraying the aqueous hydrogen peroxide. The results for the judgement of viability/mortality of bacteria are shown in Table 1 and Table 2.

Table 1

Initial number of bacteria 2.3×10^4 CFU/strip	Judgement for viability/mortality of bacteria (+: viability; −: mortality) confirmed for six samples for each condition			
	Irradiation time (Number of light emission cycles)			
Spray of aqueous hydrogen peroxide	0 sec (0 cycle)	1 sec (3 cycles)	5 sec (15 cycles)	10 sec (30 cycles)
Not sprayed		+−−−−−	+−−−−−	−−−−−−
0.1 wt%	++++++	−−−−−−	−−−−−−	−−−−−−
1.0 wt%	++++++	−−−−−−	−−−−−−	−−−−−−

Table 2

Initial number of bacteria 2.2×10^4 CFU/strip	Judgement for viability/mortality of bacteria (+: viability; −: mortality) confirmed for six samples for each condition			
	Irradiation time (Number of light emission cycles)			
Spray of aqueous hydrogen peroxide	0 sec (0 cycle)	1 sec (3 cycles)	5 sec (15 cycles)	10 sec (30 cycles)
Not sprayed		++++++	++++++	++++++
0.1 wt%	++++++	+++++−	+++−−−	++++−−
1.0 wt%	++++++	+++−−−	−−−−−−	−−−−−−

[0033] From the results shown in Table 1 and Table 2, it has been confirmed that even those bacteria which are difficult to be eliminated by using only the aqueous hydrogen peroxide or only the xenon lamps can be eliminated completely by the combined use of the aqueous hydrogen peroxide and the high power irradiation from the xenon lamps. Further, it has been found that the sterilizing time can be shortened by applying the irradiation treatment of high power pulses in a state where aqueous hydrogen peroxid is deposited.

Exampl 2

[0034] The same sterilizing test as in Example 1 was conducted for bacteria-inoculated strips with the initial number of bact ria at 2.3×10^4 cfu/strip prepared in Example 1, which was appended to the bottom of 1L cartons each opened at an upper end, which is a bottomed cylinder. Aqueous hydrogen peroxide at a concentration of 0.1% by weight and 1.0% by weight were respectively sprayed for one sec by hand spray, the bacteria-inoculated strips were fixed at a position 26 cm just beneath the xenon lamps, high power pulses from the xenon lamps were irradiated for 5 sec, 10 sec and 15 sec in a state where the aqueous hydrogen peroxide was deposited, then the strips were recovered into 10 ml of a DTB liquid culture medium, cultivated at 35°C for 10 days to confirm viability/mortality of bacteria. The results are shown in Table 3.

Table 3

Initial number of bacteria $\underline{2.3 \times 10^4}$ CFU/strip	Judgement for viability/mortality of bacteria (+: viability; −: mortality) confirmed for six samples for each condition			
	Irradiation time (Number of light emission cycles)			
Spray of aqueous hydrogen peroxide	0 sec (0 time)	5 sec (15 times)	10 sec (30 times)	15 sec (45 times)
Not sprayed		++++++	+++++−	+++−−−
0.1 wt%	++++++	+++−−−	+++−−−	++−−−−
1.0 wt%	++++++	−−−−−−	−−−−−−	−−−−−−

[0035] From the comparison between Table 3 and Table 1 in this experiment, it can be seen that since the irradiation side by the xenon lamps and the bacteria-inoculated strip was spaced by a great distance, and the opening area of the 1L carton was narrow, the amount of light reaching the bacteria-inoculated strip at the bottom of the 1L carton was decreased, and as a result, the sterilizing effect was lowered compared with the case of Example 1. However, the synergistic effect was clearly observed for the combined use of the aqueous hydrogen peroxide and the xenon lamps. Particularly, in the combined use with the aqueous hydrogen peroxide at 1.0% by weight concentration, complete sterilization was possible within 5 sec, while sterilization required for 15 sec or more when only the xenon lamps were used, and it has been confirmed that sterilization can be conducted within a processing time corresponding to the line speed of the packing and packaging machine.

Example 3

[0036] A sterilizing test was conducted using a bacteria-inoculated strip prepared at an initial number of bacteria of 1.7×10^6 cfu/strip, and using the following liquid having the antibacterial function instead of the aqueous hydrogen peroxide. Two xenon lamps were used for high power pulses from the xenon lamp, and the light was irradiated for 0.6 sec, 3 sec and 6 sec under the conditions with a light emission energy per once of 200 Joule/lamp, at light emission for 5 times in 1 sec and with an effective irradiation window area of 30 x 30 cm. Other procedures were the same as those in Example 1. The results are shown in Table 4.

Aqueous hydrogen peroxide containing peracetic acid:	0.06 wt% of peracetic acid, 0.08 wt% of hydrogen peroxide, 0.2 wt% of acetic acid
Aqueous acetic acid:	1 wt%
Ethanol:	70%
Sodium chloride solution:	1 wt%

(continued)

Electrolyzed acidic water:	50 ppm
Lactic acid solution:	1 wt%
Citric acid solution:	1 wt%

Table 4

Initial number of bacteria 1.7×10^6 CFU/strip	Judgement for viability/mortality of bacteria (+: viability; −: mortality) confirmed for 3 samples for each condition			
	Irradiation time (Number of light emission cycles)			
Kinds of spraying liquid	0 sec (0 cycle)	0.6 sec (3 cycles)	3.0 sec (15 cycles)	6.0 sec (30 cycles)
Not sprayed	+++	+++	+++	−−−
Aqueous hydrogen peroxide containing per acetic acid	+++	++−	−−−	−−−
Acetic acid	+++	+++	−−−	−−−
Ethanol	+++	+++	++−	−−−
Sodium chloride solution	+++	+++	−−−	−−−
Electrolyzed acidic water	+++	+++	+−−	−−−
Lactic acid solution	+++	+++	+−−	−−−
Citric acid solution	+++	+++	++−	−−−

[0037] From Table 4, the effect for the combined use with the high power pulse irradiation from the xenon lamps has been confirmed even in a case of using liquid having the antibacterial effect other than the aqueous hydrogen peroxide and it has been found that the sterilization time can be shortened by conducting high power pulses irradiation in a state where the liquid having the antibacterial effect was deposited.

[0038] According to this invention, since a higher sterilizing effect can be obtained within a much shorter period of time, compared with the hitherto methods, by irradiating high power pulses using the xenon lamps in a state of depositing the liquid having the antibacterial effect, sterilization can be conducted within a processing time corresponding to the line speed of the packing and packaging machine. Further, also in case of requiring a high energy when sterilization is conducted only by the xenon lamps, since a higher sterilizing effect can be obtained by using xenon lamps of a low energy type according to this invention, the cost can be lowered. Further, compared with the case of using only the liquid having the antibacterial effect, since a higher sterilizing effect can be obtained even by using a liquid at low concentration, the liquid can be removed easily after use and safety upon use is also improved.

[0039] Further, according to this invention, since high power pulses are irradiated by using the xenon lamps in a state of depositing the liquid having the antibacterial effect, the sterilizing time can be shortened as described above, and the damages to the packaging material is decreased, as well as damages to the packaging material by the high power pulses can be moderated and odoriferosity, deterioration of the seal strength and scorching caused on the printed surfaces can be prevented, by covering the surface of the products to be irradiated with the liquid.

Claims

1. A method of sterilizing a food packaging material, which comprises irradiating high power pulses by using xenon

lamps in a state in which a liquid having an antibacterial effect is deposited on a food packaging material.

2. A method of sterilizing a food packaging material as defined in claim 1, wherein the liquid having the antibacterial effect is selected aqueous peracetic acid, aqueous hydrogen peroxide containing peracetic acid, aqueous hydrogen peroxide, ozone-containing water, ethanol, sodium chloride solution, electrolyzed acidic water, organic or inorganic acid solution.

3. A method of sterilizing a food packaging material as defined in claim 1 or 2, wherein a liquid having the antibacterial effect at a concentration of an effective ingredient of from 0.1 to 10% by weight is used as the liquid having the antibacterial effect.

4. An apparatus for sterilizing a food packaging material comprising:

a means for depositing a liquid having an antibacterial effect on a food packaging material, and
a means for irradiating high power pulses by using xenon lamps to a food packaging material deposited with the liquid having the antibacterial effect.

5. An apparatus for sterilizing a food packaging material as defined in claim 4, wherein the food packaging material has a polyolefin layer on the surface.

6. An apparatus for sterilizing a food packaging material as defined in claim 4 or 5, wherein the means for depositing the liquid having the antibacterial effect on the food packaging material is one of a spray device of a liquid having an antibacterial effect to a food packaging material, a means for coating the liquid having the antibacterial effect or an immersion means of immersing the material into the liquid having the antibacterial effect.

7. An apparatus for sterilizing a food packaging material as defined in any one of claims 4 to 6, wherein the xenon lamps have spectral characteristics having a continuous spectra of a wide range of wavelength from a ultraviolet region to infrared region.

8. An apparatus for sterilizing a food packaging material as defined in any one of claims 4 to 7, wherein the xenon lamps have a light emission energy from 50 to 1000 Joule.

9. An apparatus for sterilizing a food packaging material as defined in any one of claims 4 to 8, wherein the sterilizing apparatus for the food packaging material has a preheating section capable of heating the surface temperature of the food packaging material to 40 - 80°C in a step before depositing the liquid having the antibacterial effect to the food packaging material.

10. An apparatus for sterilizing a food packaging material as defined in any one of claims 4 to 9, wherein the sterilizing apparatus for the food packaging material has a drying device for removing the liquid having the antibacterial effect deposited to the food packaging material in the step after irradiating high power pulses using the xenon lamps to the food packaging material deposited with the liquid having the antibacterial function.

Fig. 1

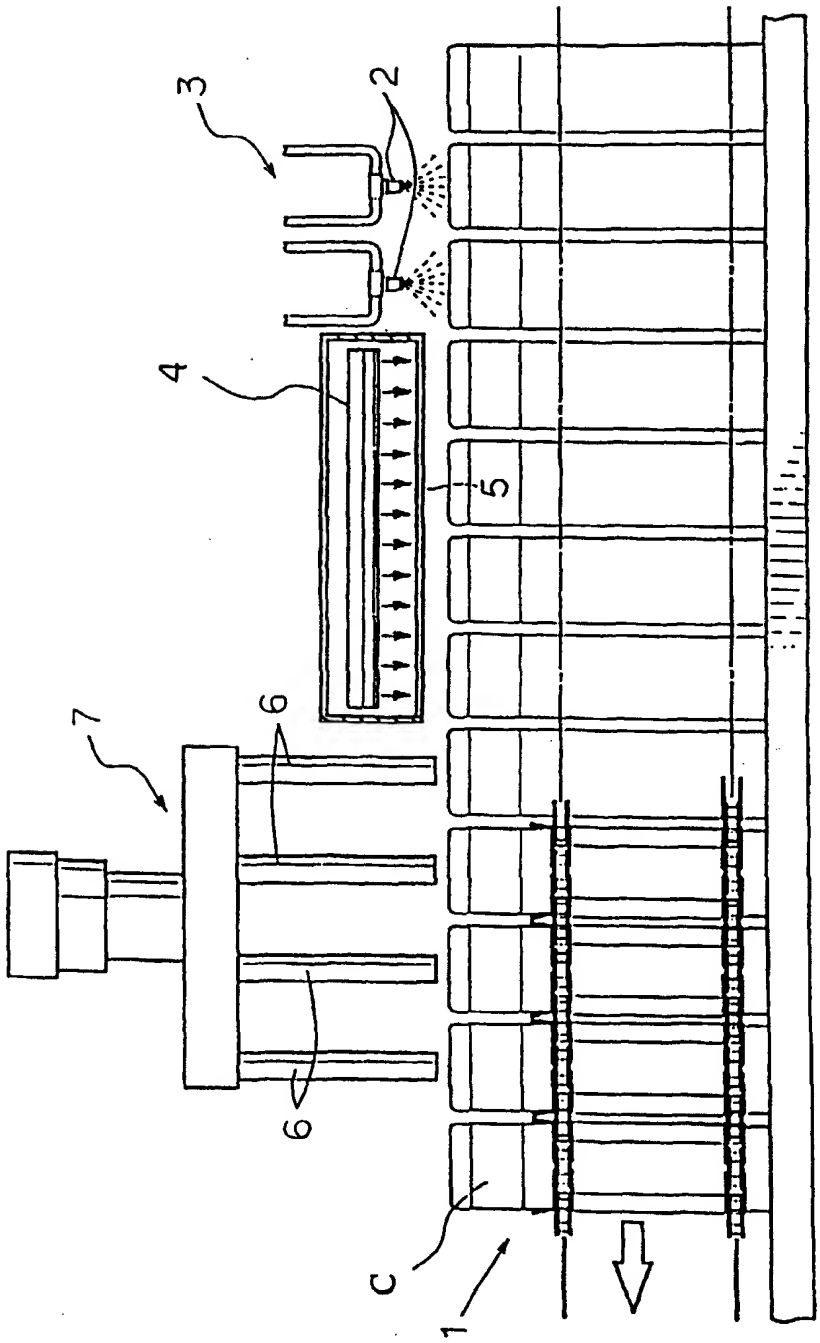

Fig. 2